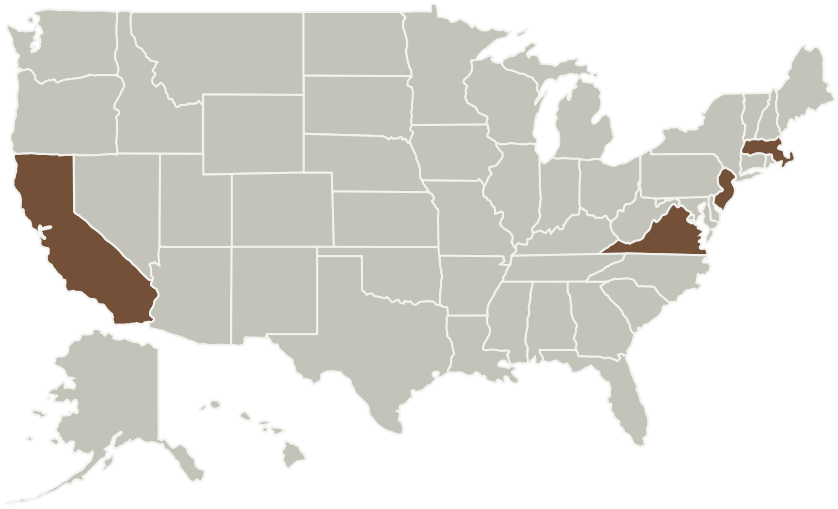
# Multi-fluid Studies of Chromospheric Reconnection in a Partially Ionized Laboratory Plasma

Completed Technology Project (2015 - 2018)

## Project Introduction

The solar chromosphere provides the critical transition between the plasma pressure dominated convection zone, where coronal magnetic fields originate, and the magnetically dominated corona, where these fields interact with each other to drive solar flares and coronal mass ejections. The reconnection and reorganization of the magnetic field from plasma-forced to magnetically-forced which occurs in this region as fields emerge from the convection zone into the corona is therefore a critical, though as yet poorly understood, process. Most of the past work in theory and simulation to model ion-neutral drag has used a single-fluid approach where an ambipolar diffusion term is added to Ohm's Law. However, this approach may not be valid for the multi-scale problem which requires multiple fluid models. We propose to contribute to this work through a collaboration between experiment and simulation. The team at the Magnetic Reconnection Experiment (MRX) has performed initial studies of reconnection in both two- and three-fluid regimes. Recent studies have focused on measurements of ion flows, but we propose to spectroscopically measure neutral flows, which can be compared to observations. For simulations, we will use HiFi, a multi-fluid code that is already being used to model reconnection in the solar chromosphere. We plan to determine how neutrals affect reconnection rate, structures in the reconnection region, and associated heating and flows in both regimes. To our knowledge, the proposed laboratory experiments are only available tools to validate numerical codes used to model reconnection phenomena in the solar chromosphere.

## Primary U.S. Work Locations and Key Partners




Multi-fluid Studies of Chromospheric Reconnection in a Partially Ionized Laboratory Plasma

## Table of Contents

# Multi-fluid Studies of Chromospheric Reconnection in a Partially Ionized Laboratory Plasma

Completed Technology Project (2015 - 2018)

| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Princeton University | Lead Organization | Academia | Princeton, New Jersey |

| Primary U.S. Work Locations | |
|---|---|
| California | Massachusetts |
| New Jersey | Virginia |

## Organizational Responsibility

**Responsible Mission Directorate:**

Science Mission Directorate (SMD)

**Lead Organization:**

Princeton University

**Responsible Program:**

Heliophysics Technology and Instrument Development for Science

## Project Management

**Program Director:**

Roshanak Hakimzadeh

**Program Manager:**

Roshanak Hakimzadeh

**Principal Investigator:**

Hantao Ji

**Co-Investigators:**

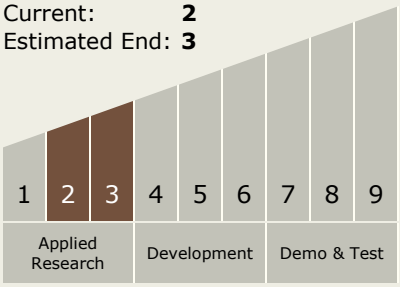
Nicholas A Murphy
Jongsoo Yoo
Vyacheslav S Lukin
Masaaki Yamada
William Fox
Bart W De Pontieu
Jeffrey Friedland

# Multi-fluid Studies of Chromospheric Reconnection in a Partially Ionized Laboratory Plasma

Completed Technology Project (2015 - 2018)

## Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**




## Technology Areas

**Primary:**

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

## Target Destination

The Sun